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10/067,029	02/04/2002	Narayan Sundararajan	884.594US1	4992

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EXAMINER

STRZELECKA, TERESA E

ART UNIT	PAPER NUMBER
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1637

DATE MAILED: 08/08/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/067,029

Applicant(s)

SUNDARARAJAN ET AL.

Examiner

Teresa E Strzelecka

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 21 April 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 4-16 and 18-31 is/are pending in the application.
- 4a) Of the above claim(s) 5,20 and 25 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 4,6-13,18,19,21-24 and 26-31 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☒ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 2.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

## **DETAILED ACTION**

### ***Election/Restrictions***

1. Applicant's election without traverse of Group I (claims 4-13 and 18-31) in Paper No. 5 is acknowledged. Applicants cancelled claims 1-3 and 14-17.
2. The restriction/election requirement contained election of species requirement for Group I, to which Applicant did not respond in writing. A phone call was made to David Peterson on August 4, 2003, resulting in the election of species containing claims 4, 6-13, 18, 19, 21-24 and 26-31.
3. Claims 5, 20 and 25 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected species, there being no allowable generic or linking claim.
4. Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).
5. Claims 4, 6-13, 18, 19, 21-24 and 26-31 will be examined in this office action.

### ***Information Disclosure Statement***

6. The information disclosure statement (IDS) submitted on February 4, 2002 is in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statement is being considered by the examiner.

### ***Oath/Declaration***

7. The oath or declaration is defective. A new oath or declaration in compliance with 37 CFR 1.67(a) identifying this application by application number and filing date is required. See MPEP §§ 602.01 and 602.02.

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The oath or declaration is defective because:

Non-initialed and/or non-dated alterations have been made to the oath or declaration. See 37 CFR 1.52(c).

Address change for Valluri Rao has not been initialed or dated.

***Claim interpretation***

8. Before proceeding with the rejections, interpretation of claim limitations is provided.

Modification of a friction coefficient of a nanotube is interpreted as resulting from changing the chemical composition of a nanotube. Any such chemical composition change will result in modification of a frictional coefficient, according to Applicants' definition of a frictional coefficient: "A friction coefficient, by definition, describes forces of interaction between at least two objects or surfaces. A friction coefficient can be described as including both an abrasive component, and an adhesive component. Abrasive friction is defined as primarily a mechanical interaction between two objects. In one example of abrasive friction, resistance to movement at an interface between two objects is generated by asperities on the surface of the objects rising past each other or breaking off. In contrast, adhesive friction is defined as primarily a chemical interaction between two objects. A friction coefficient may be determined either by abrasive factors, adhesive factors, or a combination of the two." (page 2, lines 25-30; page 3, lines 1-3).

The limitations of increasing or decreasing a frictional coefficient of nanotubes refer to a measurement of a relative quantity, i.e., the same chemical modification of a nanotube measured against two different chemical surfaces may result in either decrease or increase in the friction coefficient.

Since any chemical modification changes friction coefficient of a nanotube, the steps of modifying a frictional coefficient of a nanotube and attaching the nanotube to a reactive molecule

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are interpreted as being the same step. Applicants did not make a distinction between a “reactive molecule” and a “chemical modifier”, therefore these are interpreted as being the same molecule.

***Claim Rejections - 35 USC § 102***

9. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

10. Claims 4, 6-9, 11-13, 18, 19, 21-24, 26-28, 30 and 31 are rejected under 35 U.S.C. 102(b) as being anticipated by Woolley et al. (Chemistry and Biology, vol. 7, pp. R193-R204, 2000).

Regarding claim 4, Woolley et al. teach a method of identifying molecules (see page R193, column 2, for example) comprising:

a) modifying a friction coefficient of a carbon nanotube (Here Woolley et al teach a modification of a carbon nanotube AFM tips with carboxylic acid (COOH), -C<sub>6</sub>H<sub>5</sub> or NH<sub>2</sub> groups which constitute reactive molecules (Figure 8a; page R202, last paragraph, continued on page R203).),

b) attaching the carbon nanotube to a reactive molecule (The attachment discussed above to the carboxylic acid, -C<sub>6</sub>H<sub>5</sub> or NH<sub>2</sub> groups represent attachment of the carbon nanotube to a reactive molecule, as well as modifying the frictional coefficient (see Figure 8a, page R202, last paragraph, continued on page R203).),

c) selecting the carbon nanotube as a result of preferential interaction between the reactive molecule and sample molecule (The -COOH modified nanotubes were selected as exhibiting decreased friction with -OH sample molecules at pH greater than 4.5 (Fig. 8).),

d) placing the carbon nanotube on a substrate (The  $\text{-COOH}$  modified nanotubes were placed on a substrate with  $\text{COOH/CH}_3$  surface (Fig. 9).)

e) measuring the friction characteristics of the substrate to detect the carbon nanotube (The measurement of friction characteristics of the  $\text{COOH/CH}_3$  substrate with a  $\text{COOH}$  tip indicated increased friction in the  $\text{COOH}$  area and decreased friction in the  $\text{CH}_3$  patterned area (Figure 9)).

Regarding claim 6, Woolley et al. teach using the tip modified with a reactive molecule ( $\text{COOH}$ ,  $\text{-C}_6\text{H}_5$  or  $\text{NH}_2$ ) in an assay to determine its friction coefficient (Fig. 8, 9).

Regarding claim 7, the operations in the method of Woolley et al. were performed in the order presented (Fig. 8a; page R202, the last paragraph, continued on page R203; Fig. 8b, 9).

Regarding claim 8, the friction coefficient of the nanotube is modified after attaching the reactive molecule (see claim interpretation; Figure 8a; page R202, last paragraph, continued on page R203).

Regarding claim 9, Woolley et al. teach increasing the friction coefficient of the modified nanotube by interacting the nanotube with chemically different substrates (Fig. 8, 9).

Regarding claim 11, Woolley et al. teach attaching chemical species to the surface of the nanotube (Fig. 8a, page R202, the last paragraph, continued on page R203).

Regarding claim 12, Woolley et al. teach attaching carboxylic acid group to the surface of the nanotube (Fig. 8a, page R202, the last paragraph, continued on page R203).

Regarding claim 13, Woolley et al. teach measuring friction coefficient of a substrate by AFM (Fig. 8; page R199, the last paragraph; page R200).

Regarding claim 18, Woolley et al. teach a molecular identification assembly (an AFM carbon nanotube tip) comprising:

a reactive molecule ( $\text{COOH}$ ,  $\text{-C}_6\text{H}_5$  or  $\text{NH}_2$  group);

a carbon nanotube attached to the reactive molecule; and

a chemical modifier attached to the carbon nanotube, the chemical modifier altering the friction coefficient of the carbon nanotube (see Figure 8a; page R202, last paragraph, continued on page R203). As discussed in the claim interpretation, the reactive molecule and the chemical modifier are considered to be the same molecule.

Regarding claim 19, Woolley et al. teach using the tip modified with a reactive molecule (COOH, -C<sub>6</sub>H<sub>5</sub> or NH<sub>2</sub>) in an assay to determine its friction coefficient (Fig. 8, 9).

Regarding claim 21, Woolley et al. teach attaching carboxylic acid group to the surface of the nanotube (page R202, the last paragraph, continued on page R203).

Regarding claims 22 and 23, Woolley et al. teach increasing or decreasing the friction coefficient of the modified nanotube by interacting the nanotube with chemically different substrates, such as substrates with -COOH or -CH<sub>3</sub> groups (Fig. 8, 9).

Regarding claim 24, Woolley et al. teach a method of forming a molecular identification assembly, the method comprising:

modifying a friction coefficient of a carbon nanotube (Here Woolley et al. teach a modification of a carbon nanotube AFM tips with carboxylic acid (COOH), -C<sub>6</sub>H<sub>5</sub> or NH<sub>2</sub> groups which constitute reactive molecules (Figure 8a; page R202, last paragraph, continued on page R203).); and

attaching the carbon nanotube to a reactive molecule (The attachment discussed above to the carboxylic acid, -C<sub>6</sub>H<sub>5</sub> or NH<sub>2</sub> groups represent attachment of the carbon nanotube to a reactive molecule, as well as modifying the frictional coefficient (see Figure 8a, page R202, last paragraph, continued on page R203).)

Regarding claim 26, Woolley et al. teach increasing the friction coefficient of the modified nanotube by interacting the nanotube with chemically different substrates (Fig. 8, 9).

Regarding claim 27, the operations in the method of Woolley et al. were performed in the order presented (Fig. 8a; page R202, the last paragraph, continued on page R203; Fig. 8b, 9).

Regarding claim 28, the friction coefficient of the nanotube is modified after attaching the reactive molecule (see claim interpretation; Figure 8a; page R202, last paragraph, continued on page R203).

Regarding claim 30, Woolley et al. teach attaching chemical species: COOH, -C<sub>6</sub>H<sub>5</sub> or NH<sub>2</sub> groups, to the surface of the nanotube (Fig. 8a, page R202, the last paragraph, continued on page R203).

Regarding claim 31, Woolley et al. teach attaching carboxylic acid group to the surface of the nanotube (page R202, the last paragraph, continued on page R203).

In an alternative claim interpretation, where the reactive molecule and the chemical modifier, which changes the friction coefficient of the nanotube, are different molecules, Woolley et al. teach attaching a biotin molecule to a nanotube tip and characterizing the adhesion force between the biotinylated tip and streptavidin by AFM (Fig. 11; page R203, second full paragraph).

### ***Claim Rejections - 35 USC § 103***

11. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.



12. Claims 10 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Woolley et al. (Chemistry and Biology, vol. 7, pp. R193-R204, 2000) and Fisher et al. (U.S. Patent No. 6,203,814 B1).

A) Claim 10 is drawn to a method of claim 4, wherein modifying the friction coefficient of a carbon nanotube includes acid treating the carbon nanotube, and claim 29 is drawn to a method of claim 24, wherein modifying the friction coefficient of a carbon nanotube includes acid treating the carbon nanotube.

B) Woolley et al. teach modifying the friction coefficient of a carbon nanotube by attaching carboxylic acid to the nanotube, but do not teach treating the nanotube with acid.

C) Fisher et al. teach attaching carboxylic acid to carbon nanotubes by treating the nanotubes with nitric acid (col. 15, lines 54-67).

It would have been *prima facie* obvious to one of ordinary skill in the art at the time of the invention to have used nitric acid treatment of Fisher et al. in the method of carbon nanotube modification of Woolley et al. The motivation to do so, provided by Fisher et al., would have been that treatment with nitric acid removed undesirable materials from the surface of nanotubes in addition to functionalizing them (col. 3, lines 22-34).

13. No claims are allowed.

### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Teresa E Strzelecka whose telephone number is (703) 306-5877. The examiner can normally be reached on M-F (8:30-5:30).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Gary Benzion can be reached at (703) 308-1119. The fax phone numbers for the organization

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where this application or proceeding is assigned are (703) 308-4242 for regular communications and (703) 305-3014 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0196.

TS

August 7, 2003

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JEFFREY FREDMAN  
PRIMARY EXAMINER